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The war changed this situation. The allies and the central powers almost immediately saw the great importance of the airplane in battle and the best brains and energy of the warring nations were given to the problem of making the airplane perform what a few years ago would have been considered miraculous things.

War planes were made for various purposes, which I need not enumerate. But the most important thing done from the airplane was photographing the enemies' lines to obtain many kinds of military information, such as positions of batteries and ammunition dumps, changes in trench systems, troop movements, etc.

The same methods, with some modifications, are now being considered in connection with the mapping of extensive areas by various organizations of this country. In fact, some work has already been done and experiments are being carried on which promise excellent results.

There is so much misinformation regarding surveys and maps, that it seems appropriate for me, as the head of the oldest map-making bureau of the government, to present the mapping situation to this congress, both for your information and as a matter of record.

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Surveying and mapping have long histories and the development of the methods now employed took centuries. But the method of airplane surveying has developed like a mushroom. To what extent is it applicable to our needs? This I shall endeavor to show.

In collecting data for a map those surveying methods must be adopted in any particular case that suit the requirements. If one should wish only a route map running from one village to another, it would be perfectly satisfactory to use a compass for direction and the pacing of a horse or the readings of an odometer on a wheel for the distance between the two points. But maps are usually not so simple as that.

TYPES OF MAPS

There are several types of high grade maps needed in this country. One must be made along the coasts to show the location of the actual shore line and the character of the ground immediately back of the coast in order that the navigator may be able to locate himself from topographic features along the shore, should he be driven off his course during a storm. In addition the depths of the water and all obstructions to navigation must be indicated on this map or chart, and the elevation and shape of the ground on islands and near the shore line must be shown by contours.

A second class consists of maps on which the features other than elevations are shown in their correct horizontal positions. This type of map would be practically the same as the third type where the area covered is very level like the coastal plain of Louisiana.

The third class covers maps of the interior or of large islands on which all features, cultural and natural, are located in their proper horizontal positions and contours are shown to give the elevations of the ground and the shape of the hills, ridges, valleys, etc. This map would be used by engineers in laying out railroads and highways, and in conducting various classes of engineering work.

These three classes of maps are the ones in which we are most directly interested.

The map which shows the horizontal positions of cultural and natural features on the surface of the earth, but no contours, can be made more rapidly than the one which requires contouring. All that is needed in the former case is some method of obtaining the direction and distance between each two features in the area to be surveyed. The usual method of making such a map is by compass and chain, transit and tape, transit and stadia, or by the plane table. These methods are all very closely allied and such accuracy as may be demanded may be obtained by varying the methods used.

MAPS CONTROLLED BY FIXED POINTS

In any event there must be within the area to be surveyed, if it is a large one, a number of control stations. These control stations consist of triangulation stations placed on the highest parts of the ground or traverse stations along the roads, accurately located in latitude and longitude and accurately and substantially marked with concrete or rock in order that they may be recovered and identified by the surveyors or engineers who may wish to see them.

There are now many thousands of such stations in the United States, established principally by the Coast and Geodetic Survey, available for the fundamental control of surveys and maps. From these stations control of the same or of a lower grade of accuracy may be extended in any direction for the immediate control of topographic maps.

OVERLAPS, GAPS AND OFFSETS TO BE AVOIDED

It is readily seen that without the fundamental control, which extends over the whole area of the United States, there would be great confusion. If the control in any one state is not properly coordinated and correlated with that of any other state near it, the result will be that when different topographic surveys and maps are joined there will be overlaps, gaps and offsets which cause no end of trouble and confusion to the cartographer and map maker. When there is a single system of control for the whole country we avoid this unfortunate condition.

3,000,000 SQUARE MILES, LESS THAN ONE HALF MAPPED

There is to-day only about 40 per cent. of the 3,000,000 square miles of the United States mapped both as to horizontal positions of the

features and the elevations by contours of hills, ridges, valleys, etc. These are the maps of class three, mentioned previously. Some of the 40 per cent. of the surveyed area will have to be resurveyed because the original work was done many years ago when methods were not as refined as they are at present and the demands of map users were not as exacting as they are to-day. It is safe to say that not over 30 or 35 per cent., or one third of the whole country is adequately mapped.

The question is, what shall be done with the other 60 per cent. This is a question that is puzzling map makers constantly and no ready solution is at hand provided we insist on having a map of the whole area within a few years.

It is possible that here may be a valuable field for the airplane. It is not believed that the airplane unsupported by other surveying can give the final accuracy required in original survey. But by its means a map can be made that will be much better than the maps which may be in existence to-day in the areas not topographically mapped. In order that the remaining 60 per cent. of the country might be mapped by airplane it would be necessary to have a great amount of triangulation and traverse run with a view to furnishing the horizontal control for the photographs to be made by the airplane. With this control, it would be possible to fit the photographs on the map into their proper positions.

AIRPLANE SURVEYING WILL DEVELOP

It is not possible to run many miles with airplane photographs and expect a very high degree of accuracy in the resulting maps. And here I wish to give a word of caution to the advocates of airplane mapping. Too much must not be expected of it. The development of this science will undoubtedly be rather slow for a few years. After it has been developed the methods must, of course, be thoroughly tested before they can be adopted. It is well that this is so, for otherwise haste might cause mistakes which would discredit the method to such an extent that it would take years to recover.

CHARTS OF THE COAST

The first class of maps considered here consists of charts of the Coast and Geodetic Survey which show the level area immediately along the coast and the water area for some distance out from the shore. The purpose of coast charting is to furnish a safe means of communication by vessels along the coast or in approaching the coast. At present, the methods employed are the usual ones for the topographic surveying of the shore line and the area immediately back of it and the ordinary hydrographic methods for the surveying in the water.

Although the coast line of the United States has been mapped, yet the currents and waves of the oceans cause many large changes in this shore line. For instance Fire Island entrance, Long Island, New York, was changed in position about four miles in fifty years. The changes are so rapid that frequent resurveys of the coast must be made to furnish exact and reliable information to the navigator. It is also necessary to revise the area just back from the coast, for roads are frequently changed in position or abandoned, new ones are established, houses are built or burned, villages spring up, woods are removed or grow over what were vacant fields at the time the map was made, and all of these changes should be shown for the use of the mariner. The question arises as to how such revision shall be made.

REVISION OF CHARTS BY AIRPLANES

From the experience of the engineers of the Coast and Geodetic Survey the revision of an area that does not need contouring is almost as expensive and takes almost as much time as the original survey, for it is necessary to make a test of the position of each feature. It is here that the airplane will be of the greatest service, for if a portion of the shore line needs to be inspected with a view to learning whether or not the map of it should be revised, we could have a series of photographs made by an airplane along the coast, and a comparison of these photographs with the original map would enable one to locate very defi-

nitely each area within which there are new features or where old ones have changed. It is doubtless true that in such cases the details of an airplane photograph could be placed on the map from the photograph with all of the accuracy that is needed in the topography shown on the coast charts.

It is a debatable question as to whether the airplane photograph made over a water area will show any outline of submerged dangers to navigation when the plates are developed. If they do there is a vast field for the airplane in making photographs over water areas where it is known that many obstructions exist. With the usual surveying methods, it is difficult at times to locate every obstruction. One or more on any chart might be missed. This fact has been proved a number of times in a most disastrous way by vessels running on uncharted rocks both along our eastern and our western coasts and especially in Alaska.

The Coast and Geodetic Survey is now making wire drag surveys of all doubtful areas along the coast, but it will be many years before the bureau can assure the navigating public that all obstructions have been found and accurately charted.

AIRPLANES AND HYDROGRAPHIC SURVEYS

It may be possible that an airplane photograph will indicate submerged rocks or other dangers that are close to the surface of the water. It would be a question of differences in shade in the photograph. If such a detection of danger can be made then it will be necessary to make the photographs only on perfectly clear days. Otherwise, the shadow on the water of a passing cloud might show on the photograph and cause uncertainty as to whether the spot was a cloud or an actual obstruction.

There are many hundreds of square miles of area along the coast that consist of salt marshes with many streams of little or no importance, but which should be shown in their proper relation to other topographic features. These marshes can be photographed from airplanes and the streams running through them would probably show in such a way that they could be fitted into the map from the photograph. Here might be a large saving of time for the surveyor in the field.

There are other cases where there are extensive mud flats, when the tide is low, as in Jamaica Bay, New York. To survey the outline for these flats is rather laborious, with the usual instrumental methods, but it is believed that it might be possible to photograph them from an airplane and have the results placed on charts. It will undoubtedly be possible to get these located on the charts from airplane photographs with all the accuracy that is necessary for the navigator.

LOCATION OF DANGERS TO NAVIGATION

In making photographs from the water, for the purpose of discovering obstructions to navigation at low tide it will be necessary to have some means to properly locate photographic features on the chart. This probably can be done by anchoring two or three small boats within the area of the photograph and locating them with relation to triangulation stations. The location could be done in the usual way in which the sounding boat is today given its position, that is by taking two sextant angles simultaneously from the boat to three control points. It can readily be seen that if two or three accurately located boats are clearly shown on the aeroplane photograph, it will be possible to place the topographic details on the map in their proper positions.

I do not wish to convey the idea that the airplane photography will supersede the usual methods of hydrographic surveying, but it would supplement those methods by making it possible to discover channels running through mud flats, also coral heads, shoals, and other obstructions which might be close to the surface of the water and which may be missed by the usual methods of conducting hydrographic surveying.

There has been a rather positive statement made above that the airplane can be used to advantage in the work of the Coast and Geodetic Survey. This is undoubtedly true, but only time and the development of the methods

can show just how much the airplane can be used by this bureau.

THE AIRPLANE IN TOPOGRAPHIC MAPPING

We come now to the third class of maps and that is a subject on which I hesitate to express an opinion. That is the mapping of the interior of the country. This work is undertaken by the U. S. Geological Survey, supplemented to a certain extent by the Corps of Engineers, U. S. Army. The Coast and Geodetic Survey cooperates with those two organizations to the extent of furnishing the fundamental horizontal and vertical control for the surveys and maps, but almost all of the actual location of artificial or natural features is done by the other organizations. It is understood that the officers of those two organizations have given consideration to the question of map-making by airplane photographs. It is hoped that airplane surveying can be developed at least to supplement the usual surveyor's methods in mapping the interior on a comparatively large scale map with high accuracy.

It would appear that if the airplane photograph will be of so much assistance in the topographic work along the shores of the country that it would really be of some value in the interior.

Whether or not it is possible to locate contours from airplane photographs is a question that has not yet been decided. Many persons who have studied the question claim that it is impossible to locate contours accurately from airplane photographs. Others claim that they can be located with great accuracy. The substance of the situation is probably this: it will be possible later to devise methods of contouring from photographs provided that we can solve one or two of our present more fundamental problems. It is possible that the stereoscopic method can be applied to two photographs taken by two cameras on the same airplane or by cameras on two different airplanes together to obtain a rough idea of the configuration of the country.

SURVEYING THE INTERIOR OF THE COUNTRY

With regard to surveying the interior of the country for the purpose of making an accurate large scale, contoured map, I may say that here the airplane photographs can undoubtedly supplement the usual surveying methods, but can not entirely supplant them.

Such a map should probably be on a 1/50,000 scale, that is one foot on the map would equal 50,000 feet on the ground, and the distance between control points on the opposite edges of the area of a map should be correct within about 1 part in 10,000. The only method by which this can be accomplished is by triangulation and transit and tape traverse. The method to-day is to establish the triangulation and traverse stations ahead of the topographic surveying, with the geographic positions, that is latitudes and longitudes computed on the North American or final datum. When the control points are placed on that datum their positions will not have to be changed when two maps are joined.

The control, namely triangulation and traverse, bears the same relation to the topographic mapping of the country that the steel framework of a sky-scraper bears to the detailed portions of the building, such as walls, floors, doors, windows, etc. If the steel work is not accurately fastened and adjusted when erected, before the detailed portions are started on a building, it is reasonably certain that the building will be distorted in shape and will be structurally weak.

The same idea pertains to maps, and the difficulty mentioned actually exists to-day in some parts of our country, where the detailed mapping of certain areas had to precede the triangulation and traverse based on the North American datum. The result has been overlaps, gaps, offsets, etc., when two maps, based on different data have been joined together.

LATITUDES, LONGITUDES AND ELEVATIONS NEEDED

It is the province of the Coast and Geodetic Survey to extend the fundamental control, that is, latitudes and longitudes in long arcs throughout the country. These arcs are interlaced in order that the requisite strength may be obtained. This work has been carried on as vigorously as the funds at the disposal of the Survey would permit. We have arrived at a situation to-day which demands that this work be expedited, and it is hoped that Con-

gress will respond to our appeals for funds in order that the work may be carried on so rapidly that all mapping operations of federal, state, city, county and private organizations, may have their needs met. This is a very urgent matter and I shall do my utmost to persuade the authorities to give this branch of federal surveying ample support, in order that the country may be mapped more satisfactorily and more efficiently.

When this control is available in any area, the usual method is to have surveying parties in the field place the topographic features on the maps in their proper relation to the control points. Every object on the face of the earth has one, and only one position, and it is the duty of the surveyor to place that object, whether it is a road crossing, a bridge, the top of a hill, or any other object, in its proper position on the map. On the most exact map for military purposes a well-defined feature is placed on the map within thirty feet of its exact relation to the nearest control station. Other maps have larger allowable discrepancies.

The work involved in the topographic surveying consists not only in placing the features on the map in their correct horizontal positions, but also in showing by contours the lines of equal elevation, the slopes of the ground, the shapes of hills and the exact elevations of a number of critical points.

The elevations are based upon lines of levels run inward from the oceans. The surface of the ocean, if it were at rest, would be a continuous one, and thus the mean position of the surface serves as a datum plane from which to measure heights in the interior of the country. More than 40,000 miles of the highest grade leveling has already been established in the interior of the country, and there are more than 20,000 precise leveling bench marks whose elevations are known within a very small portion of a foot.

In addition to the above there are many thousands of miles of leveling of a lower grade of accuracy which is used for the immediate control of the topographic surveying.

It is the duty of the Coast and Geodetic Survey to extend the lines of precise leveling into the interior of the country for the purpose of furnishing starting points for the leveling needed for the immediate use of the surveyor and engineer. What has been said in regard to the fundamental horizontal control is also applicable to the precise leveling. Many more thousands of miles of this grade of leveling are needed in the United States to-day and it is hoped that the bureau may be given the support necessary to complete within the next few years the work which is now needed and should have already been done.

TOPOGRAPHIC SURVEYING WITH PLANE TABLE

The topographic surveying is done generally by means of the plane table which consists of a tripod with certain fixtures and a plane board mounted thereon. The board is approximately 24×30 inches in horizontal dimensions. On this board is placed a sheet of paper on which the topographical features are shown. On the paper there will have been placed before going to the field, the positions of the control points, and with these as starting points, the topographer weaves a net showing the various features of the earth's surface by means of symbols. These symbols have been standardized by the map users of the United States. Any one wishing to utilize the information given by one of the high-grade maps, should be thoroughly familiar with these symbols.

As far as present development of airplane photography is concerned, it seems absolutely necessary in making the contoured survey, to do the work with the present methods. One can readily understand that it would be impossible to show contours at intervals of twenty feet over a wooded area, where trees in different parts of the forest varied in height. The area photographed will not show the differences of elevations of trees in a wood, for the low trees and bushes not more than twenty feet in height, would show about the same on a photograph as a primitive forest where the trees may be seventy to one hundred feet high.

ENGINEERS NEED ACCURATE MAPS

The contoured map must be of such accuracy as to enable the highway engineers, and engineers engaged on irrigation projects, to lay out their work accurately. It can be readily seen that with an accurately contoured map, the engineer can plan the railway, the highway, etc., from one place to another, and not make great mistakes in grades and alignment. It is doubtful if, even after considerable research work, airplane photography would ever produce a map contoured accurately enough for such engineering work. It is of course possible that some method may be discovered by which the differences in elevation between two points shown on each of two separate photographs can be computed, but if one considers that the work involved, if it can be done at all, will be very great, he will see that it will probably be more economical to put the contours on the map by the usual methods, than to compute innumerable elevations from photographs.

The possible method of computing distances and elevations from photographs may be supplemented by using the stereoscopic method which would give one an idea of the configuration of the ground. This would enable the draftsman in the office to select critical points whose elevations could be determined. Such critical points would be crests of hills or ridges and the bottoms of slopes. If the elevations of critical points are determined then contours could be interpolated between them.

I am giving these statements with a good deal of reservation on my part, for the method of contouring by airplane photography has not been developed and it may be that very little can be accomplished where accurate contouring is desired. Investigation has not yet been carried to the point where one can state definitely the possibility or impossibility of contouring by this method.

AIRPLANE SUPPLEMENTS PLANE TABLE

But this accurate large-scale contoured map can undoubtedly be made by combining the usual methods of surveying with the aero-photographs. The aero-photographs will usually give a great deal of detail which may facilitate the progress of the map by the topographer using the plane table. It will be necessary of course for the topographer to select a number of definite points on his map, such as road crossings, large buildings, groups of buildings, bridges and other features which can be identified from the photographs. Those features would serve as control points for the topographic details shown on the photographs. Without such points located by the usual methods, it would be necessary to place certain conspicuous objects on the ground near the triangulation and traverse stations. Almost any kind of object that would show in the photograph, and have a distinct shape, could be used. But the placing of these objects would be expensive. It is believed that the location of the conspicuous features referred to above could be done by the topographer at a much smaller cost than the cost of placing objects for the aero-photographs, at the triangulation and traverse stations.

It is possible that the topographer would be able to place the topographic details on his map from the photographs before going into the field to do the contouring. Much of the work of the topographer by the usual methods consists in placing the topographic features on the map in their proper location, but a great deal of this might be obviated by the use of the photographs. Then he could go into the field and place the contours with greater rapidity than if he attempted to do so previous to using the details of the photographs.

AIRPLANE VALUABLE FOR MAP REVISION

What I have stated above in regard to original surveys by aero-photography, in the three classes of high-grade maps, are simply opinions or prophesies. These are the coast charts, the contoured maps of the interior, and maps which show all features except contours, but I feel confident in stating that even on the highest grade of topographic maps, the aero-photographs can be used to a great degree in revising and bringing up to date maps of that character which have already been made. Let us suppose that we have be-

fore us a topographic map made by the U. S. Geological Survey, say ten years ago, and let it be supposed that this map, at the time it was made, was absolutely perfect. The map is supposed to show the contours, woods, streams, houses and other features that are usually represented on such a map. In the ten years since the map was made, it is reasonably certain that some changes have been made by the works of man. It is improbable that natural features would have changed, such as streams, woods and hills, during such a short period. We may assume that new roads have been made, old buildings torn down, or burned, and new ones erected, that wooded areas have been cleared, and that brush or young trees may now be on areas that were bare at the time the original survey was made. In order to test such a map and learn whether it was up to date, it would be necessary by the usual methods, to send a surveyor into the field to go over the area in great detail. Of course an inspection could be made of an area by driving over it, but many changes might be overlooked by this method of inspection.

How much simpler and more reliable it would be to send an airplane over the area in question and make a series of photographs. These photographs would show at a glance, the exact areas where changes in the features had occurred, and if the changes were not too complicated it is probable that we would be able to place the new features on the map directly from the photographs. The process would be to fit in the new features between unchanged old features, which of course would also be shown on the photographs.

PHOTOGRAPHIC PLATE SHOULD BE HORIZONTAL

In what has been said above, it has been assumed that the photographs have been made with the camera vertical, or, in other words, with the photographic film or plate in a horizontal position. It is only in this way that absolutely accurate photographs could be made. If the camera is tilted from the vertical at the instant the exposure is made, then there will be a distortion of the photograph so far as the map is concerned. If this tilting were known, then the photograph could be rectified and the features shown on the map with the same accuracy as if the plate had been horizontal at the time of the exposure.

It is hoped that methods will be developed for holding the camera in a vertical position at the time of exposure. I know of none now in use which is entirely satisfactory.

CONCLUSION

I may conclude that airplane surveying can be done now and it undoubtedly has a bright future. Much experimentation must be done, however, before the airplane can be used extensively in high-grade work.

I feel that the airplane can now furnish maps of a low order of accuracy so far as scale and position of features are concerned, which will be of considerable value in many branches of industry and commerce. They will undoubtedly be extensively used in unmapped areas in this and other countries in the very near future, for reconnoissance surveys and maps. But I hope they may be of great use in more accurate work.

I can pledge the Coast and Geodetic Survey, so far as its limited resources will allow, to take its part in making such tests by airplane as may be feasible in connection with surveying and mapping.

E. Lester Jones
U. S. Coast and Geodetic Survey

TRAINING IN SUGAR TECHNOLOGY IN HAWAII

Hawaii leads the world in her applications of science to the production of cane sugar. In no other country is the cultivation of cane so highly developed, the extraction so high, the chemical control so thorough, the mill processes so accurately coordinated. The entire organization of Hawaii's sugar industry is unparalleled for business efficiency and scientific control.

The experiment station of the Hawaiian Sugar Planters' Association is recognized throughout the world for the high quality of its investigational work. Its resources are

large, varied and unique. It has a large staff of trained research men, working in the various branches of sugar production.

The College of Hawaii has a standard four-year course in sugar technology. The College of Hawaii is the territorial college of agriculture and the mechanics arts. It corresponds in general status and organization to the state colleges and universities of the mainland. A number of its graduates are now actively engaged in the sngar industry.

The Courses in Sugar Technology are designed primarily for the student who, on leaving college, intends to enter into active service in some branch of the sugar industry. Although these courses, since they prepare for one particular industry, might be termed highly specialized, the importance of a sound training in general science has not been overlooked, the first two years being devoted largely to English, mathematics, physics and chemistry.

In the third and fourth years, enough special instruction in subjects pertaining directly to the sugar industry is given so that the man who completes this course should have sufficient technical understanding to prove of some immediate value in a subordinate position on a plantation, and yet not have his future progress hampered by an inadequate theoretical training.

The cane sugar industry, as carried on in the tropics, comprises in itself two quite distinct branches; the growing of cane, and its manufacture into sugar. Inasmuch as it would be extremely difficult, if not impossible, to give thorough instruction in both these branches, in four years, the courses in sugar technology are offered in two divisions.

Agricultural Division.—The first two years are identical with the course in agriculture. In the third year quantitative analysis and organic chemistry are taken up in addition to strictly agricultural topics, for the reason that sugar production is probably more dependent on chemistry than is any other branch of agriculture. Sugar analysis is also required, as familiarity with this work is often required of a field chemist. The fourth year allows a liberal amount of electives to those students who wish to specialize in some one subject. The lectures on cane sugar manufacture are required in this year, as it is desirable that the agriculturist have some knowledge of what happens to the cane after he has grown it.

Engineering Division.—The first year is identical with the course in engineering, while the second year differs only in the substitution of qualitative analysis for advanced mechanical drawing. Chemistry is continued in the third year, together with the most essential of the engineering subjects. Students in this division take sugar analysis and sugar manufacture together with those of the agricultural division.

During the summer vacation between the third and fourth years a minimum of eight weeks' work on one of the plantations, or in connection with the work of the experiment station of the Hawaiian Sugar Planters' Association, is required of students in both divisions. To obtain credit for this, a written report of work performed is required.

The second semester of the fourth year is devoted almost entirely to practical work. Arrangements are made whereby students either serve *a special apprenticeship* on a plantation where under direction they actually perform the manual labor required at the various stations of the mill and boiling house, or else they work as assistants to men carrying on the experimental field work of the experiment station.

Students are required during this apprenticeship to take careful notes of the equipment necessary, time required and labor involved in each operation, and will meet at stated times for discussion and comparison of notes, with a view toward fixing the relationship between the theoretical principles previously studied and their practical application.

COOPERATION BETWEEN COLLEGE AND STATION

An important agreement has been effected recently between the college and the sugar planters' station, the essential points of which are as follows:

1. The station accepts College of Hawaii students in sugar technology, for a 2–3-month period during the summer, or for a 4-month period during the winter and spring. These students serve in the capacity of assistants to the field research men of the station.

2. These student assistants are appointed by the college. The college receives reports from the students, but publication rests with the station director.

3. The station pays each student assistant $45.00 per month, and pays actual transportation expenses while traveling on station work.

4. The program of work for the student assistants is of a practical nature, but with due regard to the educational features involved. The president of the college cooperates in arranging the program.

Under the provisions of this agreement, College of Hawaii students in sugar technology have remarkable apportunities and facilities for first hand familiarity with Hawaii's sugar industry.

VAUGHAN MACCAUGHEY
COLLEGE OF HAWAII

SCIENTIFIC EVENTS

LOAN EXHIBITION OF EARLY SCIENTIFIC INSTRUMENTS AT OXFORD

THE Classical Association held its annual meeting at Oxford on May 16–17, and Sir William Osler delivered the presidential address on "The Old Humanity and the New Science." We learn from *Nature* that on May 16 Sir William opened a loan exhibition of instruments and manuscripts illustrating the scientific history of Oxford from the fourteenth to the eighteenth century. The greater part of the instruments now shown have never been publicly exhibited before. They have been unearthed in cupboards and corners of libraries of colleges and university departments. They are, for the most part, in their original state and of corresponding historic value.

The two earliest dated Persian and Moorish astrolabes, A.D. 987 and A.D. 1067, lent by Mr. Lewis Evans, form a worthy introduction to a wonderful series of instruments lent by Merton College. One of these is traditionally associated with Chaucer, and another of the Saphea type is considered by Mr. Gunther to have been the instrument left by Simon Bredon either to the college or to its great astronomer, Rede, early in the fourteenth century. The energies of these early astronomrs were largely directed to the preparation of astronomical tables, which had a wide circulation, and Oxford was regarded very much as Greenwich is now.

The later astronomical exhibits illustrate the instrumental equipment of the Earl of Orrery, who must have been acquainted with the first members of the Royal Society. Many of his instruments are still in the state in which he left them to Christ Church. His telescopes of 8 feet, 9 feet and 12 feet focal length, with many-draw vellum tubes and lignum vitæ lens-mounts by Marshall and Wilson, form a unique series.

There is also a Marshall microscope of 1603 in excellent condition, as well as some magnificent planetaria and other astronomical models by Rowley, the maker of the original Orrerv.

The slide-rule of 1654 in the South Kensington Museum, must now yield to an instrument lent by St. John's College, dated 1635. It is in the form of a brass disc 1 foot 6 inches in diameter engraved with Oughtred's circles of proportion. Would space permit, the series of volvelles or calculating discs showing the age of the moon from manuscripts of the fourteenth and fifteenth centuries, and some early surveying instruments, are worthy of more particular description, as well as many other treasures now shown to the public for the first time. A printed catalogue of the principal exhibits, prepared by Mr. Gunther, of Magdalen College, is published by the Clarendon Press.

A NATIONAL POLICY OF FOREST PRESERVATION

THE first of a series of regional conferences planned to consider special conditions in various sections of the country, so that a comprehensive national policy of forest preservation may be formed, was held May 20 in the United States Department of Agriculture. After for-

est problems of New Jersey, Maryland, Virginia and West Virginia had been discussed by representatives of those states and the Forest Service of the Department of Agriculture the following resolution was presented by Colonel Eugene C. Massey, former member of the Virginia state legislature, and was adopted:

Forestry questions are national questions as well as state and local questions, and it is the sense of this conference that the national government should assume leadership in these matters and aid and cooperate with the several states in furnishing adequate protection from forest fires, in perpetuating existing forests, and in reforesting devastated forest districts or regions, upon such conditions as may seem just and necessary.

Some of the delegates suggested that the federal government should cooperate with the states in forestry work on lines similar to those prescribed in the federal aid road act and the Smith-Lever Act providing for agricultural extension work, and should make appropriations, to be matched by the states.

Among those attending the conference were: F. W. Besley, Maryland State forester, Baltimore; Dr. A. F. Woods, president, Maryland State Agricultural College, College Park, Md.; W. McCulloh Brown, member Maryland State Board of Forestry, Oakland, Md.; Alfred Gaskill, New Jersey conservation commissioner, Trenton, N. J.; R. Chapin Jones, Virginia state forester, Charlottesville, Va.; A. B. Hastings, assistant Virginia state forester, Charlottesville, Va.; Eugene C. Massie, former member of Virginia legislature, Richmond, Va.; Edwin P. Cox, member of Virginia State Geological Commission, Richmond, Va.; Nat T. Frame, state director of agricultural extension, Morgantown, W. Va.; H. S. Vandervort, assistant state agent, Morgantown, W. Va.; W. Hoyt Weber, representing Central West Virginia Fire Protective Association; W. D. Tyler, Dante, Va.; F. L. Dakin, Philadelphia, Pa.; P. S. Ridsdale, American Forestry Association, Washington, D. C.; David T. Mason, Bureau of Internal Revenue, Washington, D. C.; and a number of representatives of the Forest Service of the United States Department of Agriculture.

The second conference of the series is to be held in Asheville, N. C., June 4, for North Carolina, Tennessee and Kentucky.

PUBLICATIONS OF THE AMERICAN MEDICAL ASSOCIATION

DR. FRANK BILLINGS in reporting for the board of trustees at the Atlantic City meeting of the American Medical Association stated that the increase in subscriptions of the *Journal* of the association for the year 1918 was small—229 all told—but this under the circumstances must be regarded as satisfactory. The weekly circulation during the first four months of the current year was greater than that in any previous four months, averaging over 70,000. The foreign circulation was also steadily increasing. The advertising standard of the *Journal* had been maintained, or, if anything censorship had been more rigid. The wisdom of establishing the Cooperative Medical Advertising Bureau became more evident each year. This bureau had demonstrated that it was possible to secure for the state journals a fair amount of advertising of which the profession need not be ashamed. The bureau began this year with twenty-six state journals; the only state journal not represented was that of Illinois. The *Archives of Internal Medicine* had been conducted at a loss, while the *American Journal of Diseases of Children* showed a small profit. The Spanish edition of the *Journal* was now issued on the first and fifteenth of each month and contained practically all the scientific material in the regular edition but matter that was ephemeral or of local interest was not included. The subscriptions were coming in rapidly and at present it had a circulation of 1,400. In response to a petition signed by a large number of leading neurologists and psychiatrists the *Archives of Neurology and Psychiatry* had been established. It was published on the same terms as the *Archives of Internal Medicine*. This journal might already be regarded as a success. It was of the highest order, a credit to American medicine, and to the association. It was to be emphasized that the association was not publishing these journals for financial gain; its sole ob-

ject was to advance scientific medicine and to benefit the American medical profession. The board of trustees was of the opinion that the association should publish more of these special journals if, and when, there was a call for them. Both the American Medical Directory and the Quarterly Cumulative Medical Index showed the effects of the war and had been published at a considerable loss. The house of delegates approved a motion providing that the publication of a *Journal of Surgery* be considered and also the publication of a *Journal of Medicine* for lay readers, if the house found such a procedure advisable.

THE RAMSAY MEMORIAL FUND

A meeting of subscribers to the Ramsay Memorial Fund was held on June 5, at University College, London, for the purpose of considering plans to be submitted by the executive committee with respect to the progress of the fund and to the objects to which the fund should be devoted. The total amount already given or promised amounts to £42,794 10s. 9d. This sum includes the following contributions by the following overseas committees: Switzerland, £817 6s. 9d.; United States of America, £626 15s. 10d.; Japan, £500 9s. 2d.; India, £397 8s. 4d.; Italy, £395 16s. 8d.; Denmark, £225; Norway, £186 6s. 7d.; Chile, £128 6s. 8d.; Holland, £68 1s. 7d.; Australia, £37 16s.; New Zealand £21 3s. 6d. It also includes £5,177 18s. 6d. collected by the Glasgow committee for a Glasgow fellowship. Promises, either provisional or definite, for the foundation of one, or more than one, Ramsay Memorial Fellowship have been received from the governments of Italy, Japan, Spain, Norway, China and Greece and other governments have the matter under favorable consideration.

More recently the committee of the Ramsay Memorial Fund for the United States reports the receipts of contributions totalling $4,700, which after deduction of current expenses for printing, postage, etc., will leave about £900 for transmission to the fund headquarters in London. The committee had hoped to be able to transmit at least £1,500 at this time, and will therefore welcome further contributions. Checks should be sent to the chairman, Dr. Charles Baskerville, 140th Street and Convent Avenue, New York, or to the treasurer, Mr. William J. Matheson, 21 Burling Slip, New York.

SCIENTIFIC NOTES AND NEWS

At the meeting of the American Medical Association held in Atlantic City last week, Surgeon-General W. C. Braisted was elected president. The meeting next year will be in New Orleans. Other officers of the association were elected as follows: *First Vice-president,* D. L. Edsall, Boston; *Second Vice-president,* Emery Marvel, Atlantic City; *Third Vice-president,* Eugene S. Talbot, Chicago; *Fourth Vice-president,* George H. Kress, Los Angeles; *Secretary,* Alexander R. Craig, Chicago; *Treasurer,* William Allen Pusey, Chicago; *Speaker of House of Delegates,* Hubert Work, Pueblo, Colo.; *Vice-speaker,* Dwight H. Murray, Syracuse, N. Y.; *Trustees,* Archibald Dowling, Shreveport, La., A. R. Mitchell, Lincoln, Neb., D. C. Brown, Danbury, Conn.; *Judicial Council,* Ira C. Chase, Ft. Worth, Tex.; *Council on Health and Public Instruction,* Haven Emerson, New York City; *Council on Medical Education,* Arthur D. Bevan, Chicago; *Council on Scientific Assembly,* J. B. Blake, Boston.

The eighty-seventh annual meeting of the British Association will be held in Bournemouth from September 9 to 13, under the presidency of the Honorable Sir Charles Parsons, who will deliver an address dealing with engineerng and the war. The following presidents of sections have been appointed by the council: A, Mathematical and Physical Science, Professor Andrew Gray; B, Chemistry, Professor P. Phillips Bedson; C, Geology, Dr. J. W. Evans; D, Zoology, Dr. F. A. Dixey; E, Geography, Professor L. W. Lyde; F, Economic Science and Statistics, Sir Hugh Bell, Bart.; G, Engineering, Professor J. E. Petavel; H, Anthropology, Professor Arthur Keith; I, Physiology, Professor D. Noel Paton; K, Botany, Sir Daniel Morris; L, Educational Science, Sir Napier Shaw, and M, Agriculture, Professor W. Somerville. Evening discourses will be delivered by Sir Arthur Evans on

"The palace of Minos and the prehistoric civilization of Crete"; and by Mr. Sidney G. Brown on "The gyroscopic compass."

THE American Institute of Electrical Engineers holds its thirty-fifth annual convention at the Lake Placid Club, Lake Placid, New York, from June 24 to 27. The annual presidential address by President Comfort A. Adams will open the convention on Tuesday morning and will be followed by the introduction of President-elect Calvert Townley.

FELLOWS of the Royal Society have been elected as follows: Professor F. A. Bainbridge, Dr. G. Barger, Dr. S. Chapman, Sir C. F. Close, Dr. J. W. Evans, Sir Maurice Fitzmaurice, Dr G. S. Graham-Smith, Mr. E. Heron-Allen, Dr. W. D. Matthew, Professor C. G. Seligman, Professor B. D. Steele, Major G. I. Taylor, Dr. G. N. Watson, Dr. J. C. Willis and Professor T. B. Wood.

DEAN VICTOR C. VAUGHAN, of the University of Michigan, was elected the first president of the Medical Veterans of the World War organized at the recent meeting of the American Medical Association.

THE British government has conferred upon Major General Ireland the Cross of Companion of the Bath in recognition of his services as chief surgeon of the American Expeditionay Forces and later, as Surgeon-General of the American Army.

THE Cullum geographical medal of the American Geographical Society has been awarded to M. E. de Margerie, known for his work on physical geography.

SIR J. J. THOMSON, master of Trinity College, Cambridge, and president of the Royal Society, and Sir Norman Moore, Bart., president of the Royal College of Physicans, have been elected to the standing committee of the British Museum.

MAJOR RESTON STEVENSON, who has been working for the French government in the Chemical Warfare Service, has recently returned from France. He has been discharged from the Army, and will return to the department of chemistry of the College of the City of New York to continue his work there.

CAPTAIN PAUL E. HOWE, Sanitary Corps, has received his discharge from the Army and has resumed his work at the Rockefeller Institute, at Princeton, N. J. For several months, Captain Howe was nutritional officer at Camp Kearny, California. Later he was recalled to Washington to work out plans for a course in food and nutrition at the Army Medical School. A food laboratory has been planned and is now partially equipped for use in connection with this course and for making food analyses for the Medical Department of the Army.

PROFESSOR L. C. GRATON, who had recently returned to the Harvard geological department from work on one of the war committees in New York, has been called to Washington for the next year to establish principles of copper mine valuation and depletion for the Income Taxation program under the Treasury Department.

MR. L. E. WARREN has resigned as chief research chemist for Wm. R. Warner & Co., of New York City, and has accepted a position as associate chemist in the laboratory of the American Medical Association in Chicago.

MR. ELIOT BLACKWELDER has resigned his position as professor of geology at the University of Illinois. After September 1 he will devote his time largely to geologic research, especially regarding the history of the Rocky Mountains, with headquarters at Denver.

DR. E. D. ROE, JR., John Raymond French professor of mathematics at Syracuse University, has been elected director of the observatory. His position in the department of mathematics remains unchanged.

PROFESSOR ROLLIN D. SALISBURY, head of the department of geography and dean of the Ogden Graduate School of Science at the University of Chicago, has been appointed a member of the Illinois State Board of Natural Resources and Conservation, to succeed Professor T. C. Chamberlin, head of the department of geology.

IN the list of members of divisions of the National Research Council published in the May 16 number of SCIENCE, under the Divi-

sion of Biology and Agriculture, Botanical Society of America, the name of A. S. Hitchcock was omitted.

INFORMATION has been received from Dr. L. A. Bauer that the observations made by his party at Cape Palmas, Liberia, during the total solar eclipse of May 28–29, were successful.

DR. WALTER HOUGH left Washington in May for Arizona, to conduct ethnological and archeological explorations in the White Mountain Apache Reservation for the Bureau of American Ethnology.

MR. CHARLES M. HOY, of the National Museum, has left for Australia, to collect animals and other biological material for the museum.

PROFESSOR W. H. TWENHOFEL, of the University of Wisconsin, and a party of six students, five from the University of Wisconsin and one from Yale University, will devote the summer of 1919 to a study of the geology of Anticosti Island, Gulf of St. Lawrence. The party will leave Madison about June 20 and expects to return about October 1.

PROFESSOR J. PAUL GOODE, of the University of Chicago, gave the final address of the year's program of luncheon meetings of the Civic Industrial Section of the Association of Commerce of Chicago, in the ball room of the Morrison Hotel Thursday, May 29. The subject of the address was "America as a world power."

MAJOR A. O. LEUSCHNER, acting chairman of the Division of Physical Sciences, National Research Council, delivered an address on "The determination of the orbits of comets and planets" before the Washington Academy of Sciences on May 27.

THE Croonian lecture of the Royal Society was delivered on May 29, by Dr. H. H. Dale on "The biological significance of anaphylaxis."

THE Halley lecture was delivered by Professor Horace Lamb at the University of Oxford Museum, on May 20. The subject was "The tides."

THE Association for the Advancement of Laboratory Science among Women will offer through Dean Carey M. Thomas, of Bryn Mawr College, who is about to leave for France, $2,000 to Mme. Curie to come to the United States in 1920–21 to lecture in women's colleges and in other institutions.

Nature records the death of Dr. Milan Stefanik, formerly attached to the Meudon Observatory. In 1906 he went, with others of the staff, to the subsidiary observatory at Mont Blanc, where he continued his study of the infra-red from the point of view of telluric absorption, making his observations from different altitudes on the mountain. In 1910 Dr. Stefanik established at his own expense an observatory in the island of Tahiti to pursue his researches, and was therefore conveniently placed to observe the solar eclipse of April 28, 1911. Dr. Stefanik became a general in the French army, and met his death at a comparatively early age in an aeroplane accident in a flight from Italy to Bratislava, the capital of his native land of Slovakia.

THE death is announced of Sir Edward Charles Stirling, F.R.S., of Adelaide, South Australia, the explorer and ethnologist.

COLONEL D. RINTOUL, senior science master and head of the physics department of Clifton College, died on April 21, of pneumonia, at the age of fifty-seven years.

THE Okefinokee Society, recently organized for the purpose of bringing about the preservation for scenic and scientific purposes of Okefinokee Swamp and other natural wonders in the southeastern United States, held its first meeting at Waycross, Georgia, on June 3. This was followed in the evening by an illustrated public lecture on Okefinokee Swamp by S. W. McCallie, state geologist of Georgia, and a trip to the swamp by visiting members the next day. The society desires the cooperation of botanists, zoologists and nature-lovers throughout the country. Those who have not already been communicated with can obtain a copy of the constitution and other information by addressing the secretary, Dr. J. F. Wilson, Waycross, Georgia.

Two thousand and five hundred delegates from farmers' organizations in Washington, Oregon and Idaho in session at Seattle on June 13 subscribed $20,000 toward a fund for building a temple of agriculture in Washington, D. C.

UNIVERSITY AND EDUCATIONAL NEWS

THE sum of £200,000 is being provided by the Victorian government to enable Melbourne University to complete its buildings.

THE Goldsmiths' Company has given £5,500 to the University of Cambridge for the purpose of extending and equipping the department of metallurgy.

DR. LEVERETT D. BRISTOL has been elected dean and professor of bacteriology and public health of the University of Tennessee College of Medicine at Memphis.

DR. L. J. GILLESPIE, of the Bureau of Plant Industry, has been appointed professor of physical chemistry in Syracuse University.

FREDERICK RASMUSSEN, who has been appointed Pennsylvania state secretary of agriculture, has been succeeded in the professorship of dairy husbandry at the Pennsylvania State College by Andrew A. Borlaw, of the extension department.

AT the University of Chicago John A. Parkhurst, of the department of astronomy and astrophysics and Elbert Clark and George W. Bartelmez, of the department of anatomy, have been promoted to associate professorships.

PROFESSOR C. R. MARSHALL, professor of materia medica and therapeutics, in the University of St. Andrews has been appointed Regius professor of materia medica in the University of Aberdeen, vacant by the resignation of Professor Theodore Cash.

DR. BOON, has been appointed to the chair of chemistry at Heriot-Watt College, Edinburgh.

MR. R. W. H. HAWKEN has been appointed to succeed Professor A. J. Gibson as professor of engineering in the University of Queensland.

DISCUSSION AND CORRESPONDENCE

THE VALLEY OF TEN THOUSAND SMOKES

UNDER the caption "The Katmai National Monument" in the issue of SCIENCE, January 3, several observations and comparisons are made relative to this wonderful natural phenomenon. Among these occurs the following:

> Rock strata superheated since the great eruption underlie Katmai near enough to the surface to turn to instant steam the spring and drainage water of many a surrounding mile of foot hills. Thus originates the steam which bursts from the myriad valley vents.

An acquaintance with this remarkable volcanic area would convince the writer of the above observations that his explanations are quite inadequate to explain the phenomena occurring there and an examination of the gases evolved would still further convince the writer that he was dealing with something much more closely related to the molten magma than an area of residual superheated strata—presumably so heated in 1912 and slowly cooling off. Although steam is the principal constituent of the emanations yet there are many vents in which steam is but a small percentage of the issuing gases, the main portion of the vapors being highly corrosive acids, volatile metallic chlorides, sulphides and oxides.

It is quite true that the local surface drainage disappears as it attempts to find its way down the valley and some of the lesser conspicuous features of this valley are dumps of volcanic débris vomited out from the throats of vents into which the surface storm drainage had poured it. But the most active area of the whole valley lies right on the peninsular axis itself and no one seeing the vast quantities of vapors being evolved would for a moment consider their origin to have been up-grade surface infiltration from the distant "foot-hills."

The peninsular axis is not yet in equilibrium with the volcanic forces. In 1917 avalanches of rocks were being precipitated down the perpendicular face of Falling Mountain. Gases were issuing from crevices distributed from the bottom to the top 2,000 feet above

the level of the valley. Fifteen miles to the eastward a similar disintegration of a mountain in the peninsular axis was taking place but without the accompanying gaseous emanations. It is reasonable to assume that this axial disturbance is attributable to slow upthrust due to volcanic pressure from the underlying magma.

It is somewhat difficult to reconcile the idea of a cooling-off mass of material such as lies on the slope of Mount Lassen as the origin of the activity in the Valley of Ten Thousand Smokes. The activity is too pronounced, too constant and too evidently magmatic to admit of any explanation other than the direct volcanic origin of the gases. This valley is just as truly volcanic to-day as are the craters of Vesuvius and Kileaua. The superficial liquid lava alone is absent.

The character of the gaseous emanations points to their magmatic origin. I found that the gases as they issued were not in chemical equilibrium but continued to react after being collected, the total volume increasing. Moreover, these gases far from being spent products of volcanic action contain some of the most chemically active gases found issuing from any volcano on the face of the globe. The secondary products of these gases, that is the sublimates, etc., formed by their action on the rocks through which they pass to the surface are of a kind and quantity found only in the most active volcanic areas. Dikes of volcanic sublimates and incrustations several feet high and hundreds of yards in length mark the outlet of these subterranean emanations.

There are huge tunnels running horizontally beneath the surface of the mud flow, tunnels formed by the solvent action of the issuing gases. At the upper end of the valley seventy-five feet below the surface is a horizontal tunnel large enough to drive a team and wagon through. There are no incrustations on the walls of this passage but they are baked a brilliant brick red. It is only near the surface that the cooling off of the gases permitted the deposition of incrustants on the walls of the vents, and even here the temperature is at times so high—several hundred degrees centigrade—that little matter is deposited and the gases only become visible several feet above the opening of the vent.

Gautier[1] shows that a cubic mile of granite if forced to give up its aqueous content, as by fusion, would release 100,000,000 tons of water. Another 20,000,000 tons would be supplied if the hydrogen contained in this mass of rock could be burned. Water at a high temperature and under pressure reacts actively with other compounds that are not appreciably affected by it at ordinary temperatures. Barus[2] found that at 210°, 50 grams of water dissolved over 200 grams of glass. With carbon dioxide it forms carbon monodixe, hydrogen, methane and free carbon. It decomposes metallic sulphides and no doubt reacts upon other compounds of the metals. Should it be dissociated into its elements as is quite possible at the temperature obtaining within volcanoes then it becomes at one and the same time an oxidizing and reducing agent of the strongest character.

A better explanatory postulate for the phenomena of the Valley of Ten Thousand Smokes is afforded by considering the origin of the gaseous emanations to be that of the chemical reaction between the water content of the crust in contact with the heated magma, and the secondary reactions consequent upon the chemical activity of the water under these conditions, gives rise to the variety of gases and sublimates found issuing from the surface vents. The explosion of June, 1912, may have ruptured the sedimentary rocks underlying the valley and permitted these gases to escape through the crevices so formed or a subsidence of the valley floor may have precipitated a mass of the crust into contact with a region sufficiently hot to fuse the rocks. The pressure of the gases so formed may have caused the explosion wrecking Katmai and the floor of the valley itself. There is little doubt but that the activity is far from subsiding for

[1] *Compt. Rend.*, Vol. 143, 1906.

[2] *Am. Jour. Sci.*, Vol. 9, 1900.

Falling Mountain in 1917 was still reacting from subterranean pressure and another mountain fifteen miles to the eastward was also sending down avalanches of rocks. The presence of the lava plug Novarupta upthrust 200 feet above the floor of the upper end of the valley in 1912 is another bit of evidence that the activity of the valley is not of a secondary nature.

No other volcanic region in America offers such an opportunity for the study of the products of volcanic activity as does this. The vents are easily approachable, the gases are issuing under pressure and are not in equilibrium, the salts within many of the vents are anhydrous due to the high temperature of the issuing gases. Sublimates are in evidence every where. The valley will be a fertile field of investigation alike for the geophysicist, geologist, chemist and mineralogist. It is to be hoped that the preliminary work already commenced will be prosecuted vigorously so that nothing will be lost through the lapse of time.

The setting apart of this valley as a national monument is a fitting climax to the expeditions of the National Geographical Society and to the persistent and untiring efforts of Dr, R. F. Griggs, director of the Katmai explorations.

J. W. SHIPLEY

WINNIPEG, MAN.

QUOTATIONS

THE CONDITIONS ATTACHED TO GOVERNMENT GRANTS FOR SCIENTIFIC RESEARCH IN GREAT BRITAIN

MAY I again direct attention to the conditions under which grants are made to individual research workers by the Committee of the Privy Council for Scientific and Industrial Research (London: H.M. Stationery Office, 1919. Price £6)? The matter is of some importance, as not only are those who refuse to accept these conditions debarred from participating in the grants made from the public purse for scientific research, but other sources which used to be available, and to which such conditions were not attached, are also being cut off. I understand, for example, that the Carnegie Trust for the universities of Scotland intends very largely in the future to discontinue its grants in aid of research, and to refer applicants to the government.

By accepting a grant under these conditions, a research worker undertakes not to publish his or her results without the consent of the committee, and gives up the ownership in the commercial rights of his discoveries, which otherwise, under the patent law, belong to him. It is the committee, not the inventor or discoverer, that is to determine to what extent and in what proportion the committee and those who have made the discoveries are to secure the ownership of the results by patent, presumably on the ground that the committee has provided the funds for the research. If that is the ground, ought not the committee to state precisely what is the share it claims, whether the share is limited to the amount of the monetary contribution, or if it intends to make a profit? I understand the money was given by Parliament to foster research, not to exploit it. As it is, a worker accepting a grant places himself absolutely, as regards the legal right to his own property, in the hands of a committee, and if, as is bound to occur, differences arise as to what is the share of the discoverer or who is the discoverer, the matter is not put into the hands of an impartial arbitrator to settle, but is settled by one of the parties in the dispute. In precisely the same way, with existing secret patents, if a dispute arises between a patentee and the government, it is the treasury, who pays for the use of the patent, that settles the dispute.

The condition is justified on three grounds. First, on the ground of national interest, especially in the present abnormal circumstances, and that it is not in the national interest that results of commercial value should be made available to other countries to the detriment of our own. As regards actual war conditions, patents containing any information likely to be of use to the enemy have not been published, so this is secured independently of the question of the ownership of the patent. As regards the future, one is justified in ask-

ing whether it is the intention of the committee that the results of researches obtained by the expenditure of national funds should be kept secret, as most scientific men would regard this as short-sighted.

The second ground is that, where results are to be patented, delay in publication is in the interest of the investigator. This is scarcely relevant. It is surely in the highest degree dangerous to delay applying for a provisional patent until the results have been communicated to the committee and its consent obtained, for any person who, by lawful or unlawful means, gets the information is then in a position to prevent the real discoverer from protecting himself.

The third ground is that it is the object of the department to secure to the discoverer a fair share in any profits that may accrue from his discovery. Admittedly, the class of inventors and discoverers is in very great need of being protected from the sharp practises that have sprung up under the shadow of the patent law, and primarily from the government itself. But why should a small part of them, who receive government funds, be singled out and protected? If the discoverer prefers to secure for himself the legal ownership of his discoveries, rather than from the committee, I do not think he should be debarred from participating in this money. The most, I think, the committee has a right to stipulate is that its interest is limited to the amount it has contributed, and that, in the event of a dispute, the matter shall be referred to an impartial arbitrator for settlement.—Frederick Soddy in *Nature.*

SCIENTIFIC BOOKS

Zoologica. Scientific Contributions of the New York Zoological Society. Volume I., 1907–1915, 436 pp. 8vo, with 138 illustrations. Published by the Society, The Zoological Park, New York.

In 1906, after the New York Zoological Society had advanced its two primary objects, namely, the establishment of a great zoological park and aquarium, it entered more seriously upon its third chief object—the promotion of zoology through exploration, research and publication. Two volumes have already been published, namely "Tropical Wild Life," studies from the Tropical Station of British Guiana, and "A Monograph of the Pheasants," Volume I., by C. William Beebe. The present volume is the third to be issued; it contains twenty bulletin papers which have been published by the society beginning in 1907, and here brought together in permanent form.

The members of the scientific staff of the park and of the aquarium did not enter the well-trodden field of the lifeless cabinet or museum animal, nor of the older systematic or descriptive zoology, nor even of the newer field of experimental zoology and Mendelism; they sought the inspiring field which has been relatively little entered in this country or abroad, namely, observation of the normal living bird and the living mammal, wherever possible in its own living environment, not from the standpoint of the older naturalists or systematists, but from the standpoint of the newer problems raised in modern biology. This is a path partly pursued by certain of the older naturalists and travelers, and especially by such wonderful observers as Darwin, Wallace and Bates, which has been abandoned for a time through the lure of artificial experiment and of the breeding pen, but which may now be followed with the new ardor of a larger knowledge of the problems and of a deeper insight into the search for natural causes. These causes are sought either in the experiments which nature herself is constantly trying, or in a close imitation of the actual experiments of nature, as in Beebe's studies of the causes governing the changes of plumage and of color in the scarlet tanager (*Piranga*) and the Inca dove (*Scardafella*).

The work of Beebe, contained in the opening article of the volume, entitled "Geographic Variation in Birds," describes his initial experiments and observations, which are continued in a later paper, "Postponed Moult in Passerine Birds." In brief it is the normal and natural phenomena which are being investigated. In midsummer he placed several

scarlet tanagers and bobolinks under careful observation. Little by little the supply of light was cut off and the amount of food was increased. In about a month, when the time for the normal autumn moult arrived, the tanagers and bobolinks were living the "simple life" in a dim illumination, and, although consuming a fair amount of food, were exercising but little. As the winter gradually passed, it was evident that the birds had skipped the autumn moult entirely and appeared to suffer no inconvenience as a result. In the following spring individual tanagers and bobolinks were gradually brought under normal conditions and into their seasonal activities, with quick result. The birds moulted into the colors appropriate to the season; there was no exception; the moult was from nuptial to nuptial, not from nuptial to winter plumage; the dull colors of the winter season had been completely suppressed. Of an entirely different character is Beebe's second paper, "A Contribution to the Ecology of the Adult Hoatzin," a bird which presents a most remarkable survival both of habit and structure in the presence of claws on its wing phalanges and in its tree-climbing habits.

Interspersed with the biological papers are some which are partly biological and partly systematic, such as Beebe's third paper, "An Ornithological Reconnaissance of Northeastern Venezuela." It was learned in the zoological researches of Venezuela and in the more recent work in British Guiana, at the Tropical Research Station, that a systematic survey of the zoology and botany of any region is absolutely essential for broad and intensive biological and experimental work. Thus there also appear in this volume the first series of systematic papers on the "Insects of British Guiana," by Kellogg, Caudell and Dyar; also "Notes on Costa Rican Birds," by Crandall. These will be followed in Volume II. of *Zoologica* by very complete check-lists of the birds and mammals of British Guiana, to which the Zoological Society observers have made very extensive additions.

Of more general zoological character of the older kind are Townsend's observations on the "Northern Elephant Seal," describing his discovery of a previously unknown herd on Guadalupe, an uninhabited island lying in the Pacific Ocean 140 miles off the northern part of the peninsula of Lower California. There is also a series of morphological papers, such as those of Beebe, on the "Supernumerary Toes in Hawks," and of Gudger, on "The Whale Shark." One pathological paper has found its way into this volume, namely, that of W. Reid Blair, entitled, "Common Affections among Primates." Other papers of this character, however, will be placed in the special pathological series to be issued by the Zoological Society. It is not intended to continue in these volumes of *Zoologica* such papers as MacCallum's "Ectoparasitic Trematodes," not because they are not of interest and value, but because they belong more properly with other series of researches.

Quite germane to this volume, however, are Ditmar's observations on the "Feeding Habits of Serpents," and Beebe's careful studies on the "Racket Formation in Tail-Feathers of the Motmots," which describe the rare phenomenon of the apparent voluntary mutilation of plumage of birds with its well known bearing on Lamarckism. We have known absolutely nothing of the actual cause of this phenomenon; either how it arose, why it is so persistent, or what good is accomplished. For some reason totally unknown to us a certain portion of the central rectrices of these birds exhibits congenitally a decided degeneration of the barbs and barbules; the motmot, in the course of the preening to which it subjects all of its rectrices, breaks off the enfeebled barbs in the area most affected by this degeneration, and thus brings about the remarkable, symmetrically formed rackets. Thus an apparently purposive act is explained as being due to the weakness or hereditary degeneration in a certain portion of the tail.

The Zoological Society thus puts forth its first volume of collected contributions by younger men who have been trained chiefly within its staff and by its expeditions on land and sea, in the hope of striking the new and inspiring note which normal life always gives.

Since the materials for this first volume were collected, the same authors have found especially in the wild life of South America and of Asia materials for these and for more profound and exhaustive studies which from time to time will be published in succeeding volumes of *Zoologica*.

The present work contains 436 pages and 138 illustrations. These collected papers are handsomely bound, for free distribution to certain of the libraries which exchange with the library of the Zoological Park, and for sale to other institutions. The volumes appear under the editorship of Henry Fairfield Osborn, president of the society, with the assistance of Elwin R. Sanborn, and may be purchased by application to the secretary of the Zoological Society, New York Zoological Park.

HENRY FAIRFIELD OSBORN

May 29, 1919

SPECIAL ARTICLES

THE REASON MEAT INCREASES OXIDATION IN THE BODY MORE THAN FAT OR SUGAR

LAVOISIER[1] showed that the ingestion of food increased oxidation in the body. Rubner[2] found that of the food materials, the ingestion of meat increased oxidation most, fat next and sugar least. Several theories have been advanced in attempts to explain how food increases oxidation in the body. The one most generally accepted seems to be the theory, or some modification of the theory, of Voit, who claimed that the presence of increased quantities of food materials augmented the inherent power of the cells to metabolize. We[3] found that the ingestion of food produced an increase in catalase, an enzyme possessing the property of liberating oxygen from hydrogen peroxide, by stimulating the alimentary glands, particularly the liver, to an increased output of this enzyme, and that the ingestion of meat, in keeping with its greater stimulating effect on heat production, increased catalase more than fat or sugar. It was found that the amino acids, the essential constituents of meat or protein, were responsible for the stimulating effect of the proteins, the simple sugars for the stimulating effect of the starchy foods and the neutral fats for the stimulating effect of the fats. We found, also, that by whatever means oxidation was increased in the body, there resulted a corresponding increase in catalase. Hence, the conclusion was drawn that the increase in oxidation following the ingestion of food, as well as the increase in oxidation produced in other ways, was due to an increase in catalase.

TABLE I

Material Used	Protein Constituents			Fat Constituents			Sugar
	Glycocoll	Sodium Acetate	Acetamid	Olein	Glycerine	Potassium Oleate	Dextrose
Percentage increase in catalase	56	36	48	40	43	31	24

The object of the present investigation was to determine why the amino acids, the essential constituents of protein, stimulate the alimentary glands, particularly the liver, to a greater increase in catalase, with resulting greater increase in oxidation, than does fat, and why fat produces a greater increase than sugar. The animals used were dogs. The amino acid, glycocoll, and two related compounds, acetamid and sodium acetate; the fat, olein and its constituents, glycerine and oleic acid; and the sugar, dextrose, were the materials used. Ten grams of the sugar and of the amino acid and five grams of the fat, per kilo of body weight, were used.

After etherizing the animals, an incision in the abdominal wall was made and the material to be used was introduced in about equal quantities, into the stomach and upper part of the small intestine, by means of a hypodermic syringe. The catalase in 0.5 c.c. of blood taken from the liver was determined before as well as at intervals after the introduction

[1] Lavoisier, *Mem. de l'Acad. des Sc.*, 1780.

[2] Rubner, "Energiegesetze," 322.

[3] Burge and Neill, *The American Journal of Physiology*, Vol. 46, No. 2, May, 1918.

of the material into the stomach and intestine. The determinations were made by adding 0.5 c.c. of blood to 50 c.c. of diluted hydrogen peroxide in a bottle at approximately 22° C. and the amount of oxygen gas liberated in ten minutes was taken as a measure of the amount of catalase in the 0.5 c.c. of blood.

The maximum increase produced in the blood of the liver by the different materials is given in Table 1. It may be seen that the amino acid, glycocoll, produced 56 per cent. increase in catalase, sodium acetate 36 per cent. and acetamid 48 per cent. increase. By comparing the formulæ of these three substances it may be seen that all three are derived from acetic acid; the amino acid, glycocoll, CH_2NH_2COOH, and acetamid, CH_3CONH_2, being acetic acid, CH_3COOH, with an amino (NH_2) group introduced into the molecule while sodium acetate, CH_3COONA, has the element sodium introduced, hence the conclusion was drawn that the introduction of the amino (NH_2) group into the molecule of the organic acid, acetic, thus forming the amino acid, glycocoll, as well as acetamid, was to increase the effectiveness of the acetic acid molecule in stimulating the liver to an increased production of catalase with resulting increase in oxidation. If the introduction of the amino (NH_2) group into the other organic acids, propionic, valerianic, caproic, succinic and glutaric, thus forming the amino acids, the essential constituents of protein, increases the effectiveness of these acids in stimulating the liver to an increase output of catalase, this may explain the great increase in heat production after the ingestion of protein.

It may be seen further in Table 1, that the introduction of olein, a fat, into the alimentary tract produced 40 per cent. increase in the catalase of the blood of the liver, glycerine 43 per cent., and potassium oleate 31 per cent. increase. By comparing these figures it may be seen that glycerine produced a greater increase in catalase than did the olein and that potassium oleate produced a smaller increase. By comparing the formulæ of these substances it will be seen that the fat, olein, $(C_{17}H_{33}COO)_3C_3H_5$, has in its molecule a part of the glycerine, $C_3H_5\ (OH)_3$, molecule and a part of the oleic acid, $C_{17}H_{33}COOH$, molecule. Since oleic acid or potassium oleate produces a smaller increase in catalase than the olein, and glycerine a larger increase, it follows that the effect of the glycerine radical in the olein molecule was to increase the effectiveness of the fat in producing an increase in catalase in a manner similar to but not so extensive as did the amino (NH_2) group in the amino acids. It may be seen that the sugar, dextrose, produced a smaller increase in catalase than any of the other substances in keeping with the fact that the ingestion of sugar produces a smaller increase in oxidation than fat or protein.

Evidence is presented in this paper to show that the increased heat production following the ingestion of food is due to the stimulation of the liver to an increased output of catalase, the enzyme bringing about the oxidation and that meat or protein, in keeping with its greater stimulating effect on heat production, produces the greatest increase in catalase, fat next and sugar least. The amino (NH_2) group in the protein molecule renders protein, or meat, a more effective stimulant on catalase production and hence on heat production than fat and the glycerine radical in the fat molecule renders fat more effective than sugar.

W. E. BURGE

THE BUFFALO MEETING OF THE AMERICAN CHEMICAL SOCIETY. II

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

H. S. Miner, *Chairman*

H. E. Howe, *Secretary*

Symposium on Library Service in Industrial Laboratories

The public library in the service of the chemist: ELWOOD H. MCCLELLAND, Technology Librarian, Carnegie Library of Pittsburgh. The function of the public library is to serve its public by affording information relating to the problems of the

entire community, and since the field of modern chemistry is now so extensive as to find application in almost every line of human endeavor, it is inevitable that the library should have much to offer the chemist. Library service to the chemist should begin *before he becomes a chemist* and should be emphasized during the entire period of his professional education. The professional chemist—especially the man engaged in research or consulting work—can secure valuable assistance from the well-equipped public library. The broader his field, the greater the necessity for using the general library collection to supplement the professional library. The efficacy of the public library is dependent both upon its resources and its "attitude." Satisfactory service to the community assumes the responsibility of maintaining an up-to-date collection; of so administering this collection as to make its resources readily available; of keeping, to some extent, in contact with local technical activities and of keeping thoroughly informed as to the material in his library. Progressive library methods are necessary not only to keep regular readers informed but to bring the library's resources to the attention of professional men and manufacturers who do not habitually use the public library.

Axioms in the use and abuse of special libraries: Helen R. Hosmer, formerly of General Electric Co. Now with Dr. Geo. W. Crile Laboratory.

Methods employed in the industrial library of Eastman Kodak Company: Gertrude Reissman. The Kodak Park Library was established in 1912 in compliance with a strongly felt need for a general reference center for all involved in research work and manufacturing problems. On account of the nature of work done here, the main feature of the library is the completeness of photographic literature. It contains about 6,000 volumes and maintains subscriptions of about 200 current periodicals. Articles of interest contained therein are abstracted in a monthly publication, the *Abstract Bulletin*. Articles in foreign languages are translated, if necessary, and if the information which had been asked for can not be supplied from the library's own resources, great efforts are made to obtain it elsewhere.

Relation of the library to industrial laboratories: W. P. Cutter, The Chemical Catalogue Co., Inc.

Functions of the industrial library—that of Arthur D. Little, Inc., a type: E. D. Greenman. In order to keep in touch with chemical literature the chemist finds the frequent use of a library essential. Research investigations are now carried jointly in the library and the laboratory. That the public, college and technical libraries are not sufficiently accessible to quickly supply desired information, has given rise to the development of the industrial library. These libraries serve as storehouses where information is collected, preserved, indexed and distributed. The working functions of an industrial library and its service to the chemist are illustrated by a description of the library of Arthur D. Little, Inc.

The functions of a research library in the dyestuffs industry: Julian F. Smith, National Aniline and Chemical Co., Inc. Research Laboratory. The Schoellkopf Research Library, named in honor of the pioneer American dyestuffs makers, is classified according to the Dewey Decimal System. The plan of administration is patterned after the usage of public and institutional libraries, with modifications as required by special conditions. It consists chiefly of literature on pure and applied chemistry, the former predominating, and on engineering and physics. A wide range of other subjects is represented to a less extent. There are great possibilities open for the research library in service to the industries.

Interior publicity as an aid to the laboratory: S. M. Masse, National Carbon Co., Inc.

Long distance library service of the New Jersey Zinc Co.: L. A. Tafel. Object: To extend library service to any member of the organization wherever located. Organization: Relation to technical department, centralization of library resources, establishment of branch libraries at mines and works. Technical information service: Publication and distribution of the library bulletin.

Features of the library of Stone & Webster: G. W. Lee.

Work of the library of The Solvay Process Co.: W. L. Neill. The collecting of books and journals for this company began more than thirty years ago. Ours is particularly a special library, mainly on chemical subjects, which contains some 1,200 volumes, including bound volumes of the principal English and German chemical journals. It is in constant use by the staff of chemists. It is indexed on the Dewey system, with the usual cards. We have also, as a second part of the library, files of the principal technical journals, both American and foreign. From these we make abstracts, which are printed and sent out to about 100 men in our employ, one half of whom are in the local office and one half in our other works.

We also circulate among the officials here about twenty of the journals, which are carried out and brought in daily after three days' use.

Special library service in The Barrett Company: E. C. BUCK.

Library service in the chemical department and chemical department laboratories of the E. I. du Pont de Nemours & Company: F. I. GALLUP. The paper outlined the du Pont Chemical Department Library organization, covering especially the following points: (1) Informing the librarians of new work to be undertaken, (2) a monthly exchange of accession reports, (3) the monthly abstract, (4) the patent files and patent catalogue, (5) special research catalogue of references, (6) classification and index of information in chemical department reports, (7) bibliographical work, (8) personal.

Symposium on the Future of Certain American-made Chemicals

Some present-day problems of chemical industry: R. F. BACON and W. A. HAMOR.

A possible menace to American chemical independence: W. D. COLLINS. This paper noted a few instances of unsatisfactory deliveries of chemicals and apparatus for regular analytical work. In some lines American-made products are so superior to the foreign supplies that very few analysts would care to use the foreign articles at any price. In other lines there is some doubt as to the inferiority of American products available at the present time. Many buyers of supplies for analytical, industrial and educational laboratories would pay higher prices for satisfactory American products, but may not be willing to sacrifice time and reliability of results by using inferior products if supplies formerly used again become available. It is suggested that the industrial section or the society either appoint a new committee or enlarge the field of some committee already in existence to canvass the situation in regard to the quality of chemicals and apparatus for regular laboratory work. Such a committee, working, should be able to secure cooperation between buyers, sellers and manufacturers which would remove any lingering desire on the part of chemists for foreign-made reagents and apparatus for everyday use in the laboratories of schools, universities and industries.

Quality first to insure increased success of the chemical industry of the United States: JOKICHI TAKAMINE, JR.

Phenol: ALBERT G. PETERKIN.

Cellulose acetate: H. S. MORK.

Unusual organic chemicals: HANS T. CLARKE.

Also W. J. HALE, L. M. TOLMAN, H. A. METZ and General Information Discussion.

General Papers

Tactical uses of smoke (lantern): BYRON C. GOSS.

Chemical work in the canning industry: W. D. BIGELOW.

Corrosion tests on commercial calcium chloride used in automobile anti-freeze solutions (lantern): PAUL RUDNICK. Three proprietary products were tested for their effect on aluminum, copper and cast iron. Polished plates of these metals were immersed in solutions of the concentration directed by the manufacturers. The plates were suspended in pairs of copper and aluminum, copper and cast iron, and aluminum and cast iron, and also a set of all three, by means of copper wire attached to the emergent ends of the respective plates. The tests were continued for thirty days, the loss or gain in weight of the plates being noted every other day. The curves plotted from these results show not only that aluminum is attacked most severely, iron next, and copper least, as would be expected, but also that the rate of corrosion increases sharply on the eighteenth to twentieth day of immersion.

Oxidation in the manufacture of T.N.T.: A. S. EASTMAN. The final stage of the nitration of toluene in the manufacture of T.N.T. is carried out at such a high temperature that there is considerable oxidation of the nitrotoluenes, by the mixed acid. The extent of this oxidation is indicated by the presence of 15 to 20 per cent., of $HNOSO_4$ in the spent acids. This represents the reduction product, and it was desired to identify a corresponding quantity of oxidation products. 2-4-dinitrobenzoic acid was isolated. 1.24 per cent. of the toluene is lost by oxidation to organic acids. The gas evolved during nitration contained CO_2, CO, N_2 and O_2 in quantities sufficient to lower the yield of T.N.T. by 4.9 per cent. This gas varies in composition, but may contain sufficient CO to be explosive, causing the top of a nitrator to be blown off, without detonating the T.N.T.

A new bomb calorimeter for industrial laboratories: W. L. BADGER. The only feature of this bomb that is radically different from other well-

known types is that it is made of Monel metal and is not lined. The sulphuric and nitric acids formed during the combustion of the coal sample attack the bomb very slightly. Gravimetric sulphur determinations give the sulphur correction directly. Since some of the acids are neutralized by the metal of the bomb, the nitric acid correction can not be determined, but is ordinarily too small to affect the accuracy of determinations for industrial purposes. The result is a bomb which gives results agreeing with the standard types much closer than the ordinary errors in sampling and which can be made for a small fraction of the cost of any lined calorimeter.

Non-metallic inclusions in steel: E. G. Mahin. In this paper the origin and nature of inclusions is briefly discussed and the general effects upon the properties of the steel are noted. The principal effects are of two classes: (1) They produce the same kind of weakness as would result from cavities of similar size and form. (2) Ferrite segregation usually occurs in such a manner as that inclusions are found as nuclei of ferrite grains. If the steel is forged or rolled these grains and their inclusions become elongated and ordinary thermal treatment fails to destroy the resulting banded structure. The various theories that have been advanced to account for these facts are discussed, particular attention being devoted to the idea of Stead, to the effect that iron phosphide is entirely responsible for ferrite segregation and that inclusions have a purely incidental connection with this phenomenon. Experimental work is described, illustrated by lantern slides, as a result of which the conclusion is reached that the persistence of ferrite bands is, in fact, largely or entirely due to phosphorus, but that inclusions exert an effect upon the crystallization of ferrite which is independent of the presence of phosphorus. Certain hypotheses are advanced to account for the observed facts.

Mineral rubber: Gustav Egloff.

Manufacture of castor oil: J. H. Shrader. A description of the technology of castor oil manufacture as practised by the castor oil manufacturers, together with that of the government plant at Gainesville.

Possibility of commercial utilization of oil from cherry pits, tomato seed and grape seed: J. H. Shrader. The possibility of the commercial utilization of the canning house by-products of cherry pits, tomato seed and grape pomace is considered in the light of the economic question involved in assembling the raw material before manufacturing the finished product, together with a brief description of the technical questions involved.

Sugar saving by home-grown sugar beets: John M. Ort and James P. Withrow. This work was undertaken as a war help, though interest in the subject in rural communities and state institutions has existed for years. In the ordinary manufacture of beet sugar, the sugar is separated from the syrup by crystallization and the sugar then refined. This leaves most of the salts and strongly flavored organic impurities in the residual impoverished syrup of molasses so that it is fit only for cattle food or fertilizer. It is this material also which has rendered difficult the elimination of the beet flavor from the syrup from sugar beets. Otherwise the making of this syrup for home consumption would long ago have been an important rural home industry. Home cultivated sugar beets properly trimmed, peeled, decored and sliced were found to yield a bright syrup with good taste upon treatment with hot water after a preliminary wash and then boiling down. This gives a sweetening available for many culinary purposes and in which, with ordinary care, the characteristic beet flavor is nearly eliminated or not too prominent for use as syrup. Contrary to the published statements no simple treatment has been found which will consistently render this syrup entirely palatable but it can be used in all cases with as little real basis for objection as the sorghum syrup so much made in rural districts. It is hoped that more resourceful investigators will succeed in the entire elimination of this disagreeable flavor, and in every case. We have but dipped into the subject.

Charles L. Parsons,
Secretary

(To be continued)

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